



TOP: Collection of aquatic invertebrate samples at Thunder Lake

BOTTOM: Setting gill net to remove non-native fish in Lower Triplet Lake

Mountain Lakes Restoration

One of the principal threats facing aquatic resources in mountain lakes can be attributed to the widespread introduction of non-native fish. In the past, people thought they were improving the natural environment by stocking non-native species of fish. But, instead, the result has created many negative impacts to the ecosystem and unhealthy and non-recreationally-rewarding fisheries. The mountain lakes in North Cascades National Park are naturally fishless due to barriers such as the steep and rugged nature of the glacially carved valleys and abundant waterfalls. Though lacking in fish, the lakes are far from barren of aquatic life. When the glaciers receded following the last ice-age (approximately 11,000 years ago), a wide variety of aquatic organisms gradually colonized the mountain lakes including plankton, invertebrates, and amphibians.

Research conducted here and at other parks has demonstrated that reproducing populations of fish (established through past stocking of lakes with sufficient spawning habitat) can overpopulate a lake and measurably deplete their food base, resulting in negative impacts to native species of amphibians, insects (such as caddisflies) and zooplankton. In addition, fish predation in combination with other factors affecting the suitability of these waters to sustain native species, such as climate change and air pollutant deposition, may dramatically increase the rate of decline in these species.

The impacts of non-native trout are not just confined to lakes. Non-native trout are dispersing downstream from lakes and competing or hybridizing with threatened populations of native fish. In particular, the spread of Eastern brook trout from mountain lakes risks placing these non-natives in competition with the native and threatened bull trout.

Status

Prior to 2008, North Cascades National Park Complex had 62 lakes containing introduced fish. Fish populations in 26 of

these lakes were maintained by frequent stocking through 2008, and discontinued in 2009, following the signing of the Record of Decision regarding the Mountain Lakes Fishery Management Plan/Environmental Impact Statement. The absence of spawning habitat in these lakes does not allow for successful natural reproduction, so it is expected that future angler harvest and natural mortality will eliminate fish populations in the 26 lakes over the next ten years.

Active restoration measures are required for the remaining 36 lakes that contain reproducing populations of fish. High density populations of fish are found at 27 of these lakes and represent the first priority for restoration. Fish were removed from three of these lakes as a result of recent restoration efforts by park staff using intensive gill netting and application of antimycin, a fish toxicant. Gill net efforts to remove fish from three other lakes are nearly complete. Complete removal of fish from seven of these lakes may never be possible because of their large size and depth.



LEFT: Diobsud #1 (left) and Diobsud #2 lakes. Gill netting was used to remove all non-native fish from Diobsud #1 and gill net fish removal at Diobsud #2 are almost complete. **RIGHT:** Long-toed salamander larvae commonly found in NOCA fishless lakes

Discussion

Removal of non-native fish from mountain lakes in various protected areas has yielded very promising results. In Sequoia-Kings Canyon National Park, mountain yellow legged frogs are rapidly recolonizing lakes where populations of non-native trout were recently removed. Long-toed salamanders have recolonized a number of lakes in the Montana's Bitterroot Mountains following the eradication of introduced trout populations. In the Canadian Rockies, large crustacean zooplankton assemblages

have recovered following the elimination of fish from mountain lakes, although recovery has taken an average of almost two decades. At Mount Rainier National Park, gill net removal of brook trout from a small lake resulted in significant changes in the abundance and behavior of northwestern salamanders, with adults actively feeding during the day (instead of hiding) and more widely distributed throughout the lake. These case studies demonstrate that fish removal can lead to recovery of native organisms without further intervention, although recovery for some species can take many years.

The National Park Service will continue efforts to protect native aquatic ecosystems and endangered species in the park.



Although some fishing opportunities will be foregone, an abundance and variety of sport fishing opportunities will remain in the park, and many native aquatic organisms will benefit from this effort including some that are currently seriously threatened.

Fish removal efforts at five more lakes will begin in 2012. Restoration plans will be custom-tailored in response to each lake's particular characteristics of size, depth, and habitat complexity which influence the success of these projects. Results of the eradication efforts will be carefully monitored to evaluate the effectiveness of fish removal efforts and recovery of native species.